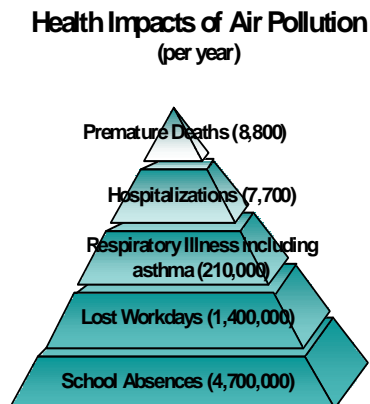


## Recent Research Findings:

### Health Effects of Particulate Matter and Ozone Air Pollution, November 2007



Although air pollution levels in California have improved significantly in the past few decades due to aggressive controls on vehicles and industry, many Californians still breathe the worst air in the nation. California's climate and geography are conducive to the formation and accumulation of air pollution (especially in Los Angeles and the Central Valley). These factors, combined with increasing population and economic growth, the dramatically increasing number of vehicle miles traveled, and other factors, make it difficult to reduce pollution levels. Higher and longer summer temperatures have also worsened smog problems. The concentrations of several pollutants not only exceed California's health-based standards, but are often measured at levels up to two or three times the standards.

Premature deaths linked to particulate matter (PM) are now at levels comparable to deaths from traffic accidents and second-hand smoke (CARB 2002a). One of the most dangerous pollutants, fine particulate matter (e.g., from diesel exhaust and fireplace soot) not only bypasses the body's defense mechanisms and becomes embedded in the deepest recesses of the lung, but also can disrupt cellular processes. Population-based studies in hundreds of cities in the U.S. and around the world have demonstrated a strong link between elevated particulate levels and premature deaths, hospital admissions, emergency room visits, and asthma attacks. Groundbreaking long-term studies of children's health conducted in California have demonstrated that particle pollution may significantly reduce lung function growth in children (Peters et al. 1999, Avol et al. 2001, Gauderman et al. 2002) and that these effects are permanent (Gauderman et al. 2004).

Another dangerous pollutant is ozone. Ozone is a powerful oxidant that can damage the respiratory tract, causing inflammation and irritation, and induces

symptoms such as coughing, chest tightness, shortness of breath, worsening of asthma symptoms, and even death. Ozone in sufficient doses increases the permeability of lung cells, rendering them more susceptible to toxins and microorganisms. The greatest risk is to those who are more active outdoors during smoggy periods, such as children, athletes, and outdoor workers. Exposure to levels of ozone above the current ambient air quality standard leads to lung inflammation and lung tissue damage, and a reduction in the amount of air inhaled into the lungs. Recent evidence has, for the first time, linked the onset of asthma to exposure to elevated ozone levels in exercising children (McConnell 2002). These levels of ozone also reduce crop and timber yields, damage native plants, and damage materials such as rubber, paints, fabric, and plastics.

Scientific research is constantly uncovering new information on air pollution health effects and the mechanisms by which pollutants damage the heart and lungs and contribute to asthma attacks and premature death.

### **Air Pollution Exposure is Associated with Premature Death**

Attaining the California PM and ozone standards would annually prevent about 8,800 premature deaths, or 3.7% of all deaths. These premature deaths shorten lives by an average of 14 years. This is greater than the same number of deaths (4,200 - 7,400) linked to second-hand smoke in the year 2000. In comparison, motor vehicle crashes caused 3,200 deaths and homicides were responsible for 2,000 deaths (CARB 2002a, CARB 2005, CDHS 2000, and Ostro et al. 2006).

### **Air Pollution Exposures Contribute to Hospitalizations**

Attaining the California PM and ozone standards would annually prevent approximately (CARB 2003a, CARB 2005):

- 6,100 hospital admissions for respiratory disease.
- 1,500 hospital admissions for cardiovascular disease.



### **Air Pollution Contributes to Respiratory Illness and Cancer**

Attaining the California PM and ozone standards would annually prevent about (CARB 2003a, CARB 2005):

- 210,000 cases of asthma and lower respiratory symptoms (such as cough).
- 17,000 cases of acute bronchitis.

Although statistics are not available for cases of lung cancer caused by all air pollutants, it is estimated that exposure to diesel PM causes about 250 excess cancer cases per year in California (CARB 2000). A recent study provides evidence

that exposure to particulate air pollution is associated with lung cancer (Pope et al. 2002). This study found that residents who live in an area that is severely impacted by particulate air pollution are at risk of lung cancer at a rate comparable to non-smokers exposed to second-hand smoke. Definitive lung cancer mortality numbers as a result of air pollution cannot yet be determined, but this study found an approximately 16 percent excess risk of dying from lung cancer due to fine particulate air pollution.

### **Air Pollution Contributes to Cardiac Illnesses**

The hearts of sensitive individuals (for example, the elderly) may be affected when they breathe in fine particulate matter. One study shows that individuals with existing cardiac disease can be in a potentially life-threatening situation when exposed to high-levels of ultrafine air pollution (Peters et al. 2001). Fine particles can penetrate the lungs and may cause the heart to beat irregularly or can cause inflammation, which could lead to a heart attack. Understanding this link is extremely important in quantifying the detrimental health effects of air pollution.

### **Air Pollution Contributes to School Absences and Lost Work Days**

On a statewide basis, 4.7 million school absence days would be avoided annually if the current levels of ozone were reduced to attain the established 8-hour state standard (CARB 2005 and Ostro et al. 2006), and 1.4 million work days would not be lost if the current levels of PM<sub>2.5</sub> were reduced to attain the annual state standard.

### **Air Pollution is Costly**

Air pollution can and does have a serious impact on the State's economy. Figures related to asthma costs and the valuation of air pollution exposure are significant and staggering. Analyses indicate that the benefits of California's air quality program exceeds the costs by a ratio of about 4 to 1 (CARB 2003c), with even greater benefits realized by diesel pollution control regulation.



In 1998, it was estimated that asthma costs in California totaled \$1.3 billion with hospitalizations and medications representing the largest direct expenditure (Asthma and Allergy Foundation of America 1998). Adult asthma patients spent an average of \$5,000 annually on medical expenses, lost wages, transportation, asthma-control products, and other asthma related expenses (Cisteinas et al. 2003).

Furthermore, an annual value of over \$1.6 billion is associated with hospitalizations and the treatment of major and minor illnesses, and about 1.4 million lost workdays each year, are all related to air pollution exposure in California. In addition, the value of premature deaths resulting from exposure to air pollution in excess of the State's PM<sub>2.5</sub> standard is nearly \$70 billion (CARB 2006, CARB 2003a, CARB 2003b, CARB 2002a, U.S. EPA. 1999).

### **Sensitive Groups Advised to Restrict Activities**

Sensitive groups, including the elderly, people with heart or lung disease, children and infants, can be at increased risk of experiencing harmful effects from exposure to air pollution. Sensitive individuals are advised to restrict certain activities when pollution levels are elevated. As indicated in the table below, based on California ozone standards that are more health-protective than federal standards, the number of unhealthy days in some areas of California ( has been approximately one out of every three days.

<b>Unhealthy Days in 2007</b>		
	<b>South Coast Air Basin</b>	<b>San Joaquin Valley</b>
Days Above National 8-Hour Ozone Standard	79	65
Days Above State 8-Hour Ozone Standard	127	138

People in almost every area in California are exposed to PM levels over the current standards.

<b>State's Population Living in Areas that Exceed PM<sub>2.5</sub> Air Quality Standards*</b>	
Annual National PM <sub>2.5</sub> Standard	57%
Annual State PM <sub>2.5</sub> Standard	90%

\*Based on the 2006 designations for PM<sub>2.5</sub>.

### **Summary of the Health Effects of Air Pollution**

<b>Particulate Matter Health Effects</b>	<b>Ground-level Ozone Health Effects</b>
<ul style="list-style-type: none"> <li>➤ Aggravated asthma</li> <li>➤ Increased respiratory symptoms</li> <li>➤ Chronic bronchitis</li> <li>➤ Increased respiratory and cardiovascular hospitalizations</li> </ul>	<ul style="list-style-type: none"> <li>➤ Aggravated asthma and possibly new cases of asthma</li> <li>➤ Reduced lung capacity</li> <li>➤ Increased susceptibility to respiratory illnesses</li> </ul>

- Decreased lung function in children
- Lung cancer
- Premature deaths

- Increased respiratory and cardiovascular hospitalizations
- Premature deaths

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